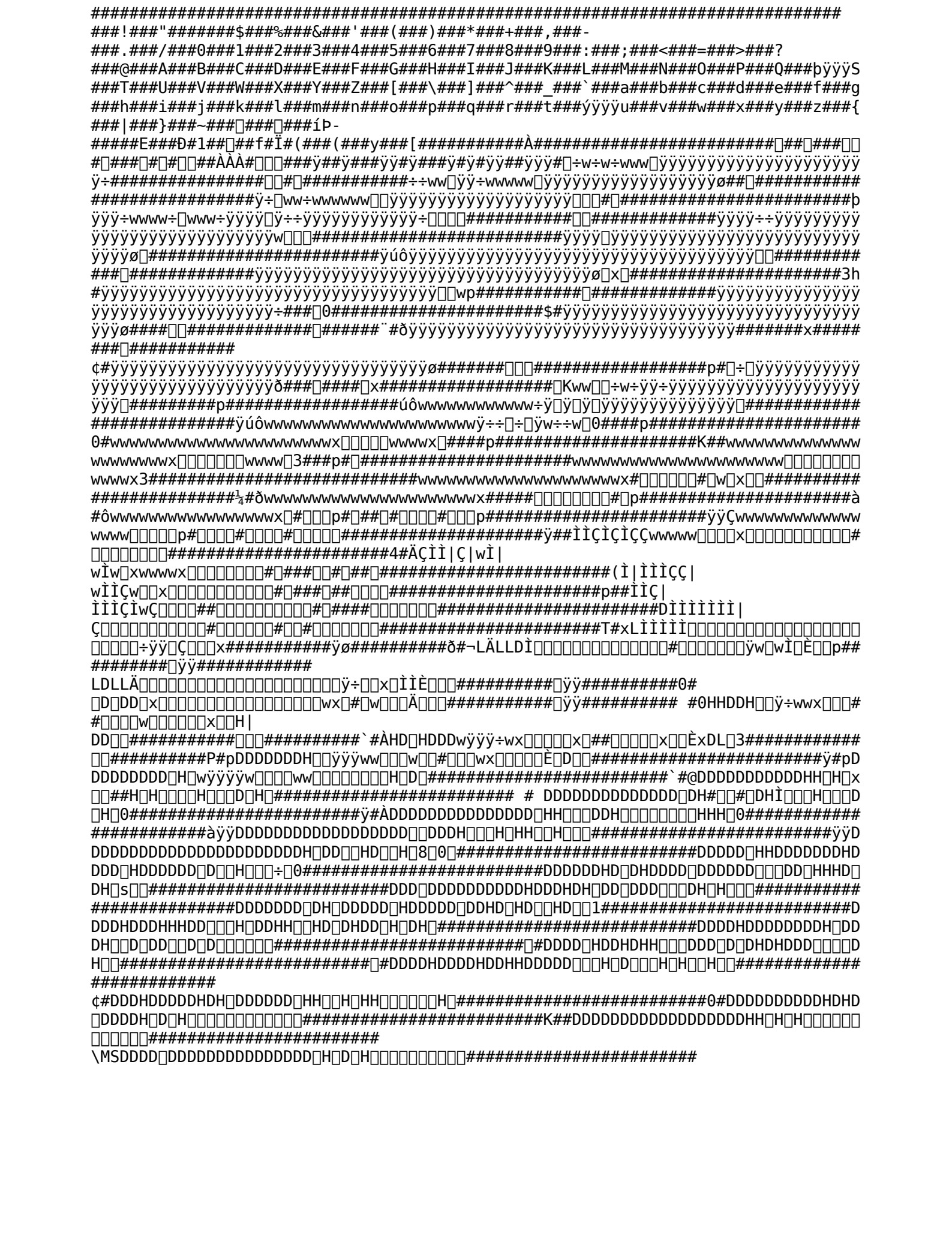

################# ##########################ÿ#ÿÿd#########U#########s####vöøý
ô#ÿÿ####ÿÿ#####ÿè#ÿÿd#########U#########»### Reflect inadequate rest Refer to symptoms associated with displaced biological rhythms Be interpreted as excessive muscular or physical activity Result from excessive mental activity#

###ÿÿ#####ÿ□#ÿÿd#########d#############Human error has been implicated in 60-80% of most occupational accidents.Although the overall rate of many types of accidents has declined steadily during the past 20 years, reductions in human error-related accidents have not paralleled those related to mechanical/environmental factors.For example, U.S. Naval aviation accidents attributable to human and mechanical/environmental factors were nearly equal in 1977. Yet by 1992, accidents solely attributable to mechanical/environmental factors had been virtually eliminated while those attributable to human error had been reduced by only 50% (Shappell & Wiegmann, 1996).If aviation accidents are to be reduced further, more needs to be done to prevent the occurrence of human error and/or to design more error-tolerant systems.#

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ì#ÿÿ####ÿÿ#####ÿè#ÿÿd#########U#########Ö###ACUTE FATIGUE a) Produced by physical exertion or sleep loss b) Alleviated by a single rest period CHRONIC FATIGUE a) Medical or psychological problem b) Depression or chronic fatigue syndrome OPERATIONAL FATIGUE a) Often caused by sleep loss and circadian desynchronization b) Often caused by continuous or sustained operations c) Most commonly seen after 3-4 days of heavy tasking d) Not relieved by a single sleep period

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Vigilance/attention Judgement Situational awareness Spatial disorientation
Simply staying awake

Wþÿÿ ###ÿÿ#####ÿ□#ÿÿd#########d#########C###SOME SKILLS ARE EASILY DEGRADEDBY
THE INSIDIOUS EFFECTS OF FATIGUE#

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¿C##########□#####s##□###ø#úõ###ÿÿ####ÿÿ#####ÿè#ÿÿd#########U#########□###Increased reaction time leads to: 1) Timing errors in response sequences 2) Less smooth controlReduced attention leads to: 1) Preoccupation with single tasks or elements 2) Reduced audiovisual scanDiminished memory leads to: 1) Forget peripheral tasks 2) Revert to □old□ habit patternsWithdrawn mood leads to: 1) Less likely to converse 2) Less likely to perform low-demand tasks

################# #########################ÿ□#ÿÿd#########U#########s##□##ßöHú! x#ÿÿ####ÿÿ#####ÿè#ÿÿd#########U#########Õ### We have an intrinsic biological clock with a cycle of roughly 24-25 hours. Many bodily functions cycle about these daily circadian rhythms a) Blood Pressure b) Heart Rate c) Core Body Temperature d) Others... Perhaps most important is that performance also cycles about normal circadian rhythms. Given the typical circadian cycle, performance peaks between 1200 and 2100 hours and falls to a minimum circadian trough between 0300 and 0600 hours.0

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While the body clock is inherently capable of monitoring the passage of time, it differs from most clocks in that its period is flexible and must be set, or synchronized, before it can accurately predict the timing of periodic environmental events. Entrainment is accomplished by external synchronizers, Zeitgebers   a) Sunrise-Sunset   b) Ambient Temperature   c) Meals   d) Social Cues#

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Modern Problem Symptomology

a) Deficits in performance, mood, motivation, and behavior

b) Sleep disturbances, lassitude, anxiety, irritability, and depression

c) Slow reaction times, defective memory for recent events, errors in computations, and a tendency to accept lower standards of performance.

################# ##########################ÿ□#ÿÿd#########U#########s##□##ßö#ü! Ö#ÿÿ####ÿÿ#####ÿè#ÿÿd#########U#########□### Rapidly traveling from one time zone to another, the body clock and rhythms it controls must resynchronize to the local geophysical and social zeitgebers. Eastward travel shortens the day. Westward travel lengthens the day. Resynchronization occurs much more rapidly when traveling west Until intrinsic circadian rhythms are resynchronized sleep disorders and fatigue will be prevalent..

################# ##########################ÿ□#ÿÿd#########U#########s##□###ö¥ûá D#ÿÿ####ÿÿ#####ÿè#ÿÿd#########U#########n### Normally, our circadian system resembles a finely tuned orchestra. After transmeridian flight, internal synchronization is adversely affected. As natural circadian rhythms become resynchronized, they do so at different rates. Circadian desynchronization (Jet Lag) is symptomatic of: a) External Desynchronization b) Internal Desynchronization c) Sleep Loss

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##########################ÿ□#ÿÿd#########U#########s##□## ù#üa#í#ÿÿ####ÿÿ#####ÿè
#ÿÿd#########U#########Þ###Non-Pharmacological Countermeasures   a) Ramping and the USMC   b) Resynchronizing tipsPharmacological Countermeasures   a) Melatonin   b) Mepiprazole hydrochloride   c) Theophylline   d) Pentobarbitone

################# ##########################ÿ□#ÿÿd#########U#########s##□##□ö□ýo P#ÿÿ####ÿÿ#####ÿè#ÿÿd#########U#########ä### Subjects lived in temporal isolation for several weeks Subjects began sleeping and waking on normal 24-h schedule After several weeks, spontaneously lengthened their day up to 48 h Body temperature only lengthened to 25 h

################# #########################ÿ□#ÿÿd#########U#########s##□##ßö#ü! ¨#ÿÿ####ÿÿ#####ÿè#ÿÿd#########U#########n### Our sleep/wake cycle is closely tied to our circadian body temperature a) Cave studies The duration and "quality" of sleep is dependent upon body temperature a) People sleep longer and report a better night's sleep when they retire near the temperature trough. It is the timing of sleep, not necessarily the amount of sleep, that is most significant.

################# ##########################ÿ□#ÿÿd#########U#########s##□##Íö□ý3 /#ÿÿ####ÿÿ#####ÿØ#ÿÿd#########U#########ø###The circadian rhythm of sleepiness (MSLT) is remarkably similar to the circadian rhythm of body temperature.There are essentially two times when your body is prepared to sleep. 1) The most obvious is between 2200-0600 2) Post-prandial dip

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Sleep requirements vary dramatically among individuals. A minimum of 5 hours of uninterrupted □core□ sleep during the circadian trough is necessary to maintain performance in the lab. Sleeping in excess of 10 hours may produce sleep drunkenness. In the cockpit, where environmental factors, and physical and mental workload exceed normal limits, the minimum amount of sleep needed to sustain performance is more.

################# ##########################ÿ□#ÿÿd#########U#########s##□##ßö?ü! □#ÿÿ####ÿÿ#####ÿè#ÿÿd#########U#########e###When sleep is not available or shortened by operational concerns, combat naps are a viable alternative.Even naps as short as 10 min are restorative in natureLong naps (typically greater than 1 h) may leave the individual feeling more tired than before napping (Sleep Inertia) a) Sleep inertia may last 5-20 min upon awakeningPractice Nappingr

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#Ô###Pharmacological     a) Barbiturates     b) Benzodiazepines     c) Aspirin
d) AntihistaminesNon-Pharmacological     a) Vigorous exercise     b) Warm baths
c) Tryptophan (milk, cheese, turkey, etc.)
```